swiss childhood cancer registry

annual report 2017 - 2018

Swiss Childhood Cancer Registry
Annual Report 2017/2018

For the Swiss Childhood Cancer Registry

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Bern, Swiss Childhood Cancer Registry

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1. Introduction

The Swiss Childhood Cancer Registry (SCCR) is the national population-based cancer registry for children and adolescents in Switzerland. New cancer diagnoses, clinical information, details on treatment and long-term follow-up (survival, second primary neoplasms, and late effects) have been registered in the SCCR since 1976. With many associated research projects and through close collaboration with clinicians it contributes to understanding the causes of cancer in children, improving follow-up care, and reducing late effects.

The SCCR is located at the Institute of Social and Preventive Medicine (ISPM) at the University of Bern. It is operated jointly by the Swiss Paediatric Oncology Group (SPOG) and the University of Bern. Since 1976, all nine Swiss paediatric haematology-oncology centres report newly diagnosed cases to the registry and send annual updates on clinical follow-up. Since 2007, the SCCR also collects supplementary data from other sources, including cantonal cancer registries, other hospitals, pathology laboratories and the Swiss Federal Statistical Office (SFSO). As of 31st December 2018, data from of 12008 cases (diagnosed in 11850 patients) have been registered. Until now, it was not compulsory to register newly diagnosed cancer cases in the registry. From 1st of January 2020 this will change with the new federal law on cancer registration.

The SCCR is authorized to collect non-anonymised data. The permission has been issued in 2007 by the Federal Commission of Experts for Professional Secrecy in Medical Research (Eidgenössische Expertenkommission für das Berufsgeheimnis in der medizinischen Forschung). Since 2014 the new act on human research is in place. The SCCR got a new authorization issued by the ethics committee of the canton of Bern in July 2014.

The SCCR is an associated member of the National Institute for Cancer Epidemiology and Registration (NICER), of the European Network of Cancer Registries (ENCR) and of the International Association of Cancer Registries (IACR), and collaborates with childhood cancer registries throughout Europe.

What did the Swiss Childhood Cancer Registry achieve in more than 40 years?

- Performed national childhood cancer surveillance of high quality; cancer registration will be compulsory in Switzerland from 1st of January 2020 onwards
- Provided reliable statistical routine data including tumour, treatment, and late effects information
- Established a competitive research platform
- Gave competent ad hoc answers to health-, environmental-, socio-, political-related questions
- Cooperated closely with all paediatric oncologists,
- Established a strong network with Swiss parents organisations

This ninth report covers the routine analyses of all children diagnosed between 1st January 1976 and 31st December 2018. Activities, research, and publications of the SCCR are described for the years 2018 to 2019. The report contains:

- An overview of the organisation and team of the SCCR, SPOG, and the participating paediatric haematology-oncology centres **(Chapter 2)**
- A summary of the data collected in the registry up to 31st December 2018 **(Chapter 3)**
- A summary of current research of the SCCR **(Chapter 4)**
- A list of publications **(Chapter 5)**

Our website (www.childhoodcancerregistry.ch) contains further information, including past annual reports and scientific publications.

We would like to thank all the children and their families, and all adolescent and adult childhood cancer survivors, for allowing us to collect their data. We also thank the physicians and clinical research coordinators of the Swiss Paediatric Oncology Group for their excellent collaboration. Our thanks also go to the cantonal cancer registries, the National Institute for Cancer Epidemiology and Registration (NICER), the Swiss Federal Statistical Office (SFSO), the Federal Office of Public Health (FOPH), and the pathology laboratories for their cooperation. Finally, we thank our supporters for their generous contributions.

2. Organisation of the Swiss Childhood Cancer Registry

The Swiss Childhood Cancer Registry (SCCR) is a member of the Swiss Paediatric Oncology Group (SPOG) and is organised as a joint operation of the Institute of Social and Preventive Medicine (ISPM) at the University of Bern and the SPOG.

2.1 Institute of Social and Preventive Medicine (ISPM), University of Bern

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2.3 General information

Aims

The Swiss Childhood Cancer Registry collects information on the diagnosis, treatment, and follow-up of children and adolescents with cancer in Switzerland, and provides data for national and international statistics and research projects.

It aims:

- To collect representative, population-based data on cancer in children and adolescents in Switzerland (cancer incidence, prevalence, time trends, regional distribution, and survival rates)
- To document diagnostic evaluations, treatment, and participation in clinical trials
- To describe short-term and long-term prognosis (mortality, morbidity, and quality of life) after cancer in childhood and adolescence
- To provide a research platform for clinical, epidemiological, and basic research

It thus contributes to:

- Research into the aetiology of cancer in children and adolescents
- Planning of health services
- Continuous improvement of treatment
- Identifying possible late effects of therapy, with the aim to diagnose and treat them early and prevent them in the future

Inclusion criteria

The SCCR registers all children and adolescents aged 0 to 20 years, resident or treated in Switzerland, diagnosed with:

- Acute and chronic leukaemias, including myelodysplastic syndrome
- Lymphomas
- Malignant solid tumours
- Central nervous system tumours (CNS), malignant and benign tumours
- Langerhans cell histiocytosis (LCH), Hemophagocytic lymphohistiocytosis (HLH)

Since 2014 it also registers children and adolescents diagnosed with:

- Aggressive fibromatosis (ICD-O-3M code 8821/1)
- Benign/mature teratoma (ICD-O-3M code 9080/0)
- Mesoblastic nephroma (ICD-O-3M code 8960/1)
- Severe aplastic anaemia (ICD-10 D61.9)
- Neoplasms of the liver, histologically proven, but no malformations

Children and adolescents who are not Swiss residents but are diagnosed or treated in Switzerland are registered, but they are excluded from analyses of incidence and survival.

Sources of data

Data on children and adolescents with cancer are collected from several sources, including:

- The nine Swiss centres for paediatric oncology and haematology (**Chapter 2.2**)
- Other hospitals
- Cantonal cancer registries, united in the National Institute for Cancer Epidemiology and Registration (NICER)
- The Swiss Federal Statistical Office (SFSO; Swiss mortality statistics)
- Pathology laboratories, Paul Scherrer Institute (PSI)

Most children are reported by one of the nine Swiss centres for paediatric oncology and haematology. There, local clinical research coordinators complete forms for all newly diagnosed patients. Basic information on diagnosis is later completed with information on treatments, remissions, relapses, transplantations, and health outcomes. These forms are sent to the SCCR and information is entered into the database. Important medical documents (e.g. pathology reports) are scanned and stored electronically using a pseudonym. Paper copies are destroyed. Information on Swiss residency is validated through municipal population registers.

For the first five to ten years after diagnosis follow-up data is extracted annually from patients' hospital records by the local clinical research coordinators in all paediatric oncology and haematology centres (**Chapter 3.3**). To assess outcomes after the children have left the clinic, patients are contacted directly with a questionnaire and data is linked to mortality records (SFSO) and to records from cantonal cancer registries (**Chapter 4.2**). Life status update is assessed through community registries. For children not treated in a paediatric oncology and haematology centre, clinical follow-up from hospitals is often not available, but long-term epidemiological follow-up is done via questionnaires and by assessment of second primary neoplasms and mortality as for the other patients, and life status update via community registries (**Chapter 3.3**).

Clinical database

The current SCCR database was set up in 2007. The following information is routinely collected:

- Tumour diagnosis, date of diagnosis, morphology, topography, stage, metastases
- Other diagnoses (cancer-relevant pre-existing conditions)
- Relevant laboratory and clinical data
- Treatment (clinical trial participation, chemotherapy, radiotherapy, surgical intervention, bone marrow transplantation) and treatment centres involved
- Follow-up data (changes of treatment, remissions, relapses, survival/death, and cause of death)
- Late adverse outcomes (e.g. cardiovascular diseases, second primary neoplasms, and endocrine disorders)

Trust centre

Since 2010, personal information (name and address) is stored in a separate database in the trust centre. The trust centre validates addresses, residence status, nationality, and vital status via community registers. This personal information is separated strictly from clinical information of the SCCR database. The following data is collected:

- Patient name, address of residence at time of diagnosis, current address of residence
- Date of birth, sex, first language
- Country of residence and nationality at time of diagnosis
- Vital status and date of death
- Parental profession, parental date of birth

Tumour coding

All tumours are coded according to the following international classification systems (see appendix):

- International Classification of Childhood Cancer, third edition (ICCC-3)
- International Classification of Diseases for Oncology, third edition (ICD-O-3)
- International Classification of Diseases and Related Health Problems, tenth revision (ICD-10)

In the annual report, the main diagnostic groups of the ICCC-3 are used:

I. Leukaemias, myeloproliferative diseases, and myelodysplastic diseases
II. Lymphomas and reticuloendothelial neoplasms
III. CNS and miscellaneous intracranial and intraspinal neoplasms
IV. Neuroblastoma and other peripheral nervous cell tumours
V. Retinoblastoma
VI. Renal tumours
VII. Hepatic tumours
VIII. Malignant bone tumours
IX. Soft tissue and other extraosseous sarcomas
X. Germ cell tumours, trophoblastic tumours, and neoplasms of gonads
XI. Other malignant epithelial neoplasms and malignant melanomas
XII. Other specified and unspecified malignant neoplasms

Langerhans cell histiocytosis (LCH), which is not included in ICCC-3, is reported separately.

Data protection

In 2004, the SCCR received a special authorisation (Sonderbewilligung) from the Swiss Federal Commission of Experts for Professional Secrecy in Medical Research. Starting from June 2007, a general authorization (Registerbewilligung) permitted the data collection from paediatric cancer patients (children and adolescents) throughout Switzerland after obtaining written, oral or silent consent.

Since January 2014 the new Human Research Act and its three ordinances are in place. Out of those three ordinances, the ordinance on Human Research with the exception of Clinical Trials provides the new framework for the SCCR. Instead of the Swiss Federal Commission of Experts for Professional Secrecy in Medical Research, data collection and storage by the SCCR now require an authorisation by the ethics committee of the canton of Bern. The general authorization (Registerbewilligung) has been replaced in July 2014 by an approval from the ethics committee of the canton of Bern

From January 2020 onwards all patients with childhood cancer are obliged to be registered by federal law.

Funding

The SCCR thanks the following supporters for their financial contributions towards the daily operation and the continuous development of the registry. Supporters of scientific research of the SCCR are listed in **Chapter 4**.

Main funding sources 2017/2018

- Schweizerische Konferenz der kantonalen Gesundheitsdirektoren und -direktorinnen (GDK)
- Swiss Paediatric Oncology Group (SPOG)
- University of Bern, Institute of Social and Preventive Medicine (ISPM)
- Krebsforschung Schweiz
- Kinderkrebshilfe Schweiz

Other funding sources 2017/2018

- Federal Office of Public Health (through National Institute for Cancer Epidemiology and Registration [NICER])
- Research contribution NICER
- Kinderkrebs Schweiz
- Celgene GmbH
  (through Förderverein Schweizer Kinderkrebsregister)

3. Routine Analyses

3.1 Overview

The SCCR registers all tumours diagnosed and treated in Switzerland, classified according to the ICCC-3 and Langerhans cell histiocytosis (LCH) in patients aged 0 to 20 years at time of diagnosis. This annual report covers the time period from 1st January 1976 until 31st December 2018. The additional rare disorders, which are registered since 2014 (see inclusion criteria under paragraph 2.3), have not been included in the following analyses. Incidence rates are calculated based on the number of primary neoplasms (cases). The number of cases slightly exceeds the number of patients because patients with more than one primary tumour diagnosed before age 20 years are counted separately for each new tumour.

The section on routine analyses includes three chapters:

Chapter 3.2 presents data on all cases registered in the SCCR. This includes cases resident in Switzerland or abroad, who were diagnosed or treated in Switzerland.

Chapter 3.3 presents data on cases resident in Switzerland, aged 0 to 14 years at diagnosis. This correspondents to the age group usually covered in international publications. Therefore, tables and figures can be compared with data from other countries. Because registration in Switzerland is more than 95% complete for this age range with estimated incidence and survival rates close to their true value.

Chapter 3.4 presents data on cases resident in Switzerland, aged 15 to 20 years at diagnosis. Patients of this age group are treated in a large number and variety of clinics and therefore registration is less complete. Incidence rates cannot be calculated for this age group.

3.2 All cases registered in the SCCR (N=12008)

This chapter describes data from all cases diagnosed 1976-2018, resident in Switzerland or abroad, diagnosed or treated in Switzerland (N=12008).

Up to 31st December 2018, a total of 12008 cases classifiable according to the ICCC-3, or Langerhans cell histiocytosis (LCH), have been registered in the SCCR. These tumours were diagnosed in 11850 patients. Among these, 11690 patients had only one primary neoplasm, 156 patients had two primary neoplasms, and 4 patients had three primary neoplasms at age 0-20 years.

The SCCR started in 1976. Initially, only patients aged 0 to 15 years who participated in clinical trials were registered. Non-trial patients have been included since 1982, resulting in a significant increase in the number registered. In the early 1990s, the introduction of the first electronic database further increased case registration (**Figure 1**).

In the last five years (2014-2018), a total of 1690 newly diagnosed cases were registered; among them 1494 cases in Swiss residents **(Table 1)**.

Swiss residents account for 10815 (90%) of all cases and foreign residents for 1193 (10%) cases **(Table 2)**. Swiss residents make up 33% (193/587) of all retinoblastoma patients, while foreign residents make up 67% (394/587) of these patients. This is due to the international reputation of the Jules Gonin Hospital in Lausanne, which is the national centre for retinoblastoma treatment but also attracts many patients from abroad.

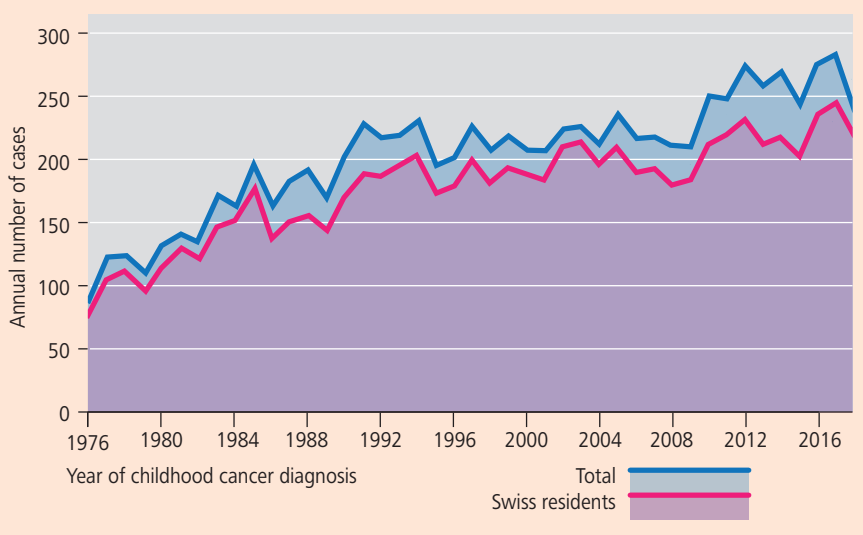


Figure 1
Annual number of registered cases over time
Swiss and foreign residents, age at diagnosis 0-14 years; period of diagnosis 1976-2018; all diagnoses (ICCC-3 or Langerhans cell histiocytosis); N= 8736

Table 1
Total number of cases registered in the SCCR, by period of diagnosis

	All patients		Swiss residents		Foreign residents	
Year of diagnosis	Age at diagnosis (years)		Age at diagnosis (years)		Age at diagnosis (years)	
	0-14	15-20	0-14	15-20	0-14	15-20
1976-1983	1021	324	911	303	110	21
1984-1988	897	338	781	314	116	24
1989-1993	1036	369	891	344	145	25
1994-1998	1059	408	943	385	116	23
1999-2003	1081	402	995	386	86	16
2004-2008	1091	477	973	458	118	19
2009-2013	1238	577	1066	571	172	6
2014-2018	1313	377	1125	369	188	8
Total	**8736**	**3272**	**7685**	**3130**	**1051**	**142**

Swiss and foreign residents, age at diagnosis 0-20 years; period of diagnosis 1976-2018; all diagnoses (ICCC-3 or Langerhans cell histiocytosis); N=12008

Table 2
Total number of cases registered in the SCCR, by country of residence

	Age at diagnosis (years)					
	All ages (0-20)		Children (0-14)		Adolescents (15-20)	
	n	%	n	%	n	%
Switzerland	10815	90.1	7685	88.0	3130	95.7
Foreign countries	1193	9.9	1051	12.0	142	4.3
Europe	860	7.2	777	8.9	83	2.5
Neighbouring countries	*437*	*3.6*	*378*	*4.3*	*59*	*1.8*
Austria	13	0.1	13	0.1	0	0.0
France	155	1.3	116	1.3	39	1.2
Germany	82	0.7	79	0.9	3	0.1
Italy	185	1.5	169	1.9	16	0.5
Liechtenstein	2	0.0	1	0.0	1	0.0
*Other European countries**	*423*	*3.5*	*399*	*4.6*	*24*	*0.7*
Middle East	46	0.4	37	0.4	9	0.3
North Africa	165	1.4	128	1.5	37	1.1
Other African countries	52	0.4	45	0.5	7	0.2
Other countries	70	0.6	64	0.7	6	0.2
Total	**12008**	**100**	**8736**	**100**	**3272**	**100**

Swiss and foreign residents, age at diagnosis 0-20 years; period of diagnosis 1976-2018; all diagnoses (ICCC-3 or Langerhans cell histiocytosis); N=12008

*Albania, Armenia, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Cyprus, Czechia, Estonia, Finland, Georgia, Greece, Hungary, Ireland, Kosovo, Latvia, Lithuania, Luxembourg, Moldova, Monaco, Montenegro, Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, Russia, Serbia, United Kingdom

3.3 Swiss residents aged 0-14 years at diagnosis (N=7685)

This chapter reports on cases aged 0-14 years and resident in Switzerland at diagnosis with a tumour coded according to ICCC-3 or a Langerhans cell histiocytosis. Results for this age group can be compared directly to data from other countries.

Diagnoses

The International Classification of Childhood Cancer (ICCC-3) distinguishes 12 groups of cancers (**Table 3**). The most common are leukaemias (32% of all cancers), followed by tumours of the central nervous system (21%; especially brain tumours); and lymphomas (12%). Other cancers arise from embryonic tissue. These include neuroblastoma (7%) from primitive neural tissue, renal tumours (5%), hepatic tumours (1%), germ cell tumours (3%), and retinoblastoma (3%).

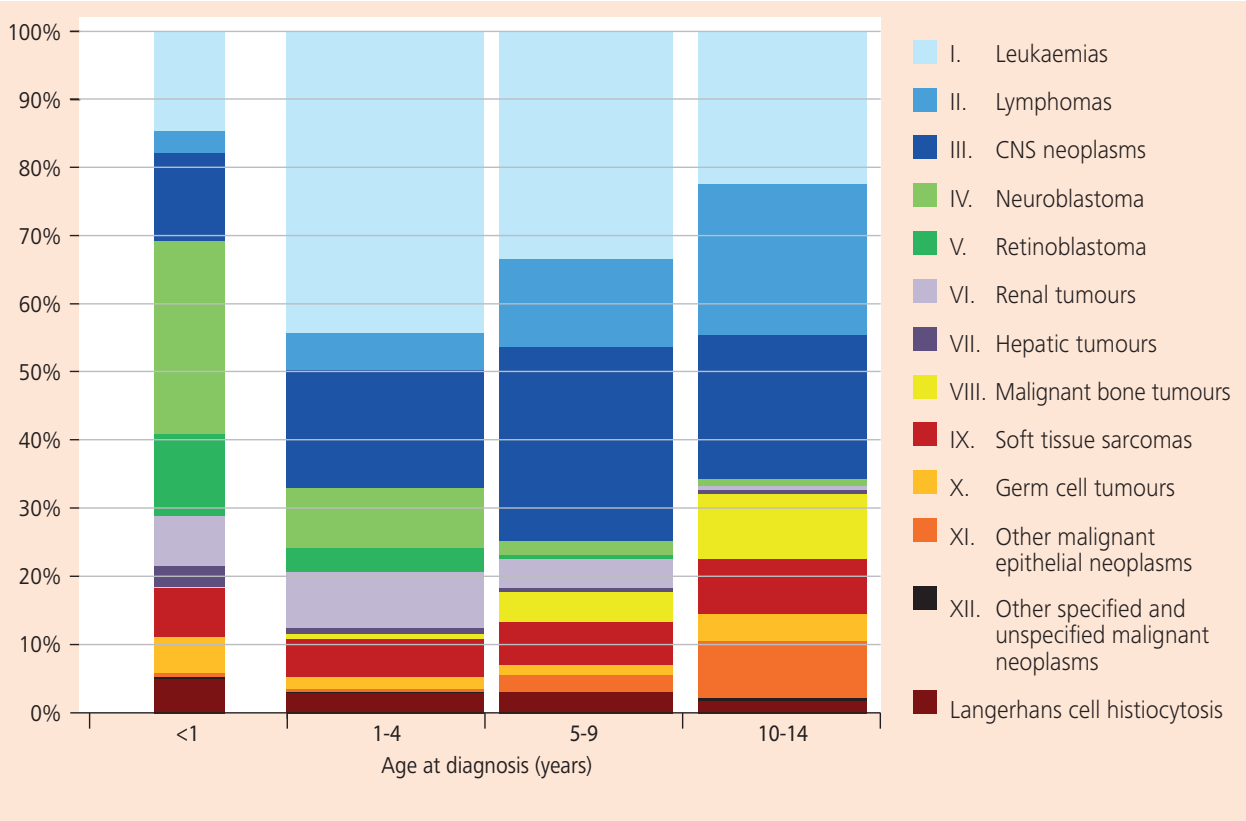
Germ cell tumours may arise in the gonads (ovaries and testes), or in other sites, such as the brain (intracranial germ cell tumours). Soft tissue sarcomas (7%), and malignant bone tumours (4%) arise from abnormal connective tissue. Occasionally, children also develop carcinomas such as melanomas or other rare tumours (3%). Langerhans cell histiocytosis (3%) is officially not counted as a malignant disease. But as children with this disease are treated similarly to those with cancer and in rare cases also die, they are recorded in the Swiss Childhood Cancer Registry. The relative frequency of the different tumour types varies with age (**Table 3** and **Figure 2**).

Table 3 - Main diagnostic groups according to ICCC-3, by age at diagnosis

	All children		By age at diagnosis (years)							
			<1		1-4		5-9		10-14	
Diagnosis	n	%	n	%	n	%	n	%	n	%
I Leukaemias, myeloproliferative diseases, and myelodysplastic diseases	2457	32.0	113	14.7	1162	44.1	680	33.3	502	22.4
II Lymphomas and reticuloendothelial neoplasms	927	12.1	24	3.1	144	5.5	267	13.1	492	22.0
III Central nervous system neoplasms	1610	20.9	100	13.0	455	17.3	581	28.4	474	21.2
IV Neuroblastoma and other peripheral nervous cell tumours	513	6.7	218	28.3	232	8.8	41	2.0	22	1.0
V Retinoblastoma	193	2.5	92	11.9	91	3.5	9	0.4	1	0.0
VI Renal tumours	377	4.9	56	7.3	217	8.2	90	4.4	14	0.6
VII Hepatic tumours	71	0.9	24	3.1	26	1.0	9	0.4	12	0.5
VIII Malignant bone tumours	325	4.2	1	0.1	18	0.7	94	4.6	212	9.5
IX Soft tissue and other extraosseous sarcomas	513	6.7	55	7.1	148	5.6	128	6.3	182	8.1
X Germ cell tumours, trophoblastic tumours, and neoplasms of gonads	206	2.7	41	5.3	45	1.7	30	1.5	90	4.0
XI Other malignant epithelial neoplasms and malignant melanomas	247	3.2	4	0.5	11	0.4	49	2.4	183	8.2
XII Other specified and unspecified malignant neoplasms	18	0.2	2	0.3	4	0.2	2	0.1	10	0.4
Langerhans cell histiocytosis	228	3.0	40	5.2	80	3.0	64	3.1	44	2.0
Total	**7685**	**100**	**770**	**100**	**2633**	**100**	**2044**	**100**	**2238**	**100**

Swiss residents; age at diagnosis 0-14 years; period of diagnosis 1976-2018; all diagnoses (ICCC-3 or Langerhans cell histiocytosis); N=7685

Figure 2
Main diagnostic groups according to ICCC-3, by age at diagnosis



Swiss residents; age at diagnosis 0-14 years; period of diagnosis 1976-2018; all diagnoses (ICCC-3 or Langerhans cell histiocytosis); N = 7685

Follow-up information

The SCCR collects follow-up information for patients in several ways:

1. **Clinical follow-up** is any contact the patient has with the paediatric oncology and haematology centre. Annual clinical follow-up care in paediatric centres usually ends 5-10 years after diagnosis. Then the patient is officially discharged or referred to an adult oncology centre. Alternatively clinical follow-up also ends as soon as the patient dies.
2. **Long-term epidemiological follow-up** for vital status, subsequent neoplasms, and current health employs four complementary approaches:
   - **Vital status** and **current address** and place of birth are updated by contacting municipal population registers. Vital status is known for most cases: among the 7566 patients, 1829 (24%) have died, and 5737 (76%) are still alive (**Table 4**). Among these, most (4295) have been followed-up during the past 5 years, 939 (12%) have last been followed up between 2009 and 2013, and only 503 (7%) before 2009. Among the latter, 122 (43 between 2009-2013 and 79 before 2009) are lost to follow-up, because they moved abroad.
   - **Causes of death** are retrieved from Swiss mortality statistics by record linkage.
   - **Second primary neoplasms** are notified via paediatric oncology and haematology centres, detected by regular comparison with cantonal (regional) cancer registries in Switzerland, or self-reported by survivors and then validated with pathology reports.
   - **Morbidity and quality of life** are assessed by paper questionnaires to survivors in the Swiss Childhood Cancer Survivor Study and Childhood Cancer Follow-up Study (**Chapter 4.2**).

Table 4 - Follow-up information available in the SCCR

	n	%
Alive	5737	75.8
Last clinical follow-up 2014-2018	4295	56.8
Last clinical follow-up 2009-2013	939	12.4
Last clinical follow-up before 2009	503	6.6
Deceased	**1829**	**24.2**
Total	**7566**	**100.0**

Swiss residents; age at diagnosis 0-14 years; period of diagnosis 1976-2018; all diagnoses (ICCC-3 or Langerhans cell histiocytosis); N= 7566 patients (7685 cases)

Survival

Long-term survival has improved significantly over the last decades (**Figure 3**).

Ten-year survival increased from 62% in children diagnosed between 1976 and 1988, to 73% in children diagnosed between 1989-1998, 84% in children diagnosed between 1999 and 2008, and 87% in children diagnosed within the last decade (2009-2018).

Survival varied widely between diagnostic groups. **Figure 4** presents survival by diagnostic group according to ICCC-3 in children diagnosed between 1999 and 2018. Of 4112 children, 645 (16%) have died. The following numbers describe five-year survival for each main diagnostic group: 100% for Langerhans cell histiocytosis; 98% for retinoblastoma; 95% for germ cell tumours; 95% for lymphoma; 94% for renal tumours; 87% for children with leukaemia; 80% for hepatic tumours; 78% for neuroblastoma; 78% for soft tissue sarcomas; 74% for central nervous system neoplasms, and 73% for malignant bone tumours.

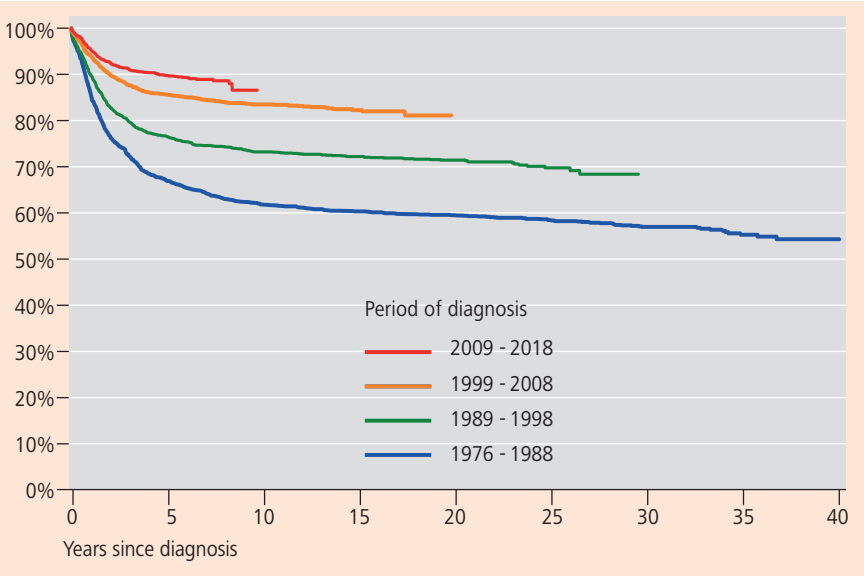


Figure 3
Survival of patients in the SCCR, by period of diagnosis

Swiss residents; age at diagnosis 0-14 years; period of diagnosis 1976-2018; all diagnoses (ICCC-3 or Langerhans cell histiocytosis); N=7685; adjusted for age.

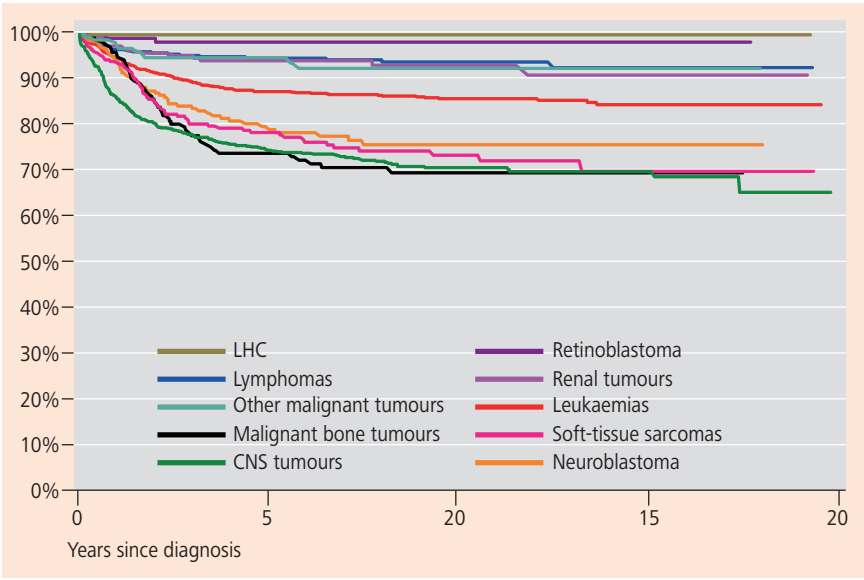


Figure 4
Survival of patients by diagnostic groups according to ICCC-3

Swiss residents; age at diagnosis 0-14 years; period of diagnosis 1999-2018 all diagnoses (ICCC-3 or Langerhans cell histiocytosis); N=4112; adjusted for age.

Cancer incidence (2009-2018) in Switzerland, for children aged 0-14 years at diagnosis

Table 5 describes the tumours registered in the SCCR during the last ten years (2009-2018). Diagnoses are coded according to ICCC-3.

The age-standardised incidence (according to the European standard population) of any childhood cancer (not including Langerhans cell histiocytosis) was 17,3 per 100'000 person-years. Incidence was highest among children aged 2 years with 24,8 cases per 100'000 person-years (boys 28,9, girls 20,5). Incidence was lowest in 9 year olds with 11,6 cases per 100'000 person-years (boys 13,8, girls 9,2) **Figure 5** shows crude incidence rates in Swiss residents; age at diagnosis 0-14 years; period of diagnosis 1999-2018; all diagnoses (ICCC-3 but not including Langerhans cell histiocytosis); **Figure 6** shows age- and sex-specific incidence rates for age 0-14).

Table 5
Childhood cancer diagnosed in Switzerland 2009-2018: number of cases, relative frequency, sex ratio, median age at diagnosis, and incidence standardised according to the Swiss standard population, by diagnostic groups according to ICCC-3

	Diagnosis	n	Relative frequency	Sex ratio (male:female)	Age at Dx (Median)	Incidence*
I	**Leukaemias, myeloproliferative diseases, and myelodysplastic diseases**	**686**	**32.3**	**1.6**	**4.9**	**5.6**
	a. Lymphoid leukaemias	546	79.6	1.5	4.8	4.4
	b. Acute myeloid leukaemias	83	12.1	1.7	6.3	0.7
	c. Chronic myeloproliferative diseases	14	2.0	2.5	12.4	0.1
	d. Myelodysplastic syndrome and other myeloproliferative diseases	36	5.2	3.0	4.3	0.3
	e. Unspecified and other specified leukaemias	6	0.9	0.2	1.0	0.0
II	**Lymphomas and reticuloendothelial neoplasms**	**214**	**10.1**	**1.9**	**10.9**	**1.7**
	a. Hodgkin lymphomas	90	42.1	1.0	12.6	0.7
	b. Non-Hodgkin lymphomas (except Burkitt lymphoma)	64	29.9	1.9	8.7	0.5
	c. Burkitt lymphoma	55	25.7	8.2	8.1	0.4
	d. Miscellaneous lymphoreticular neoplasms	5	2.3	0.7	2.8	0.0
	e. Unspecified lymphomas	**0**	**NA**	**NA**	**NA**	**NA**
III	**CNS and miscellaneous intracranial and intraspinal neoplasms**	**508**	**23.9**	**1.2**	**6.6**	**4.1**
	a. Ependymomas and choroid plexus tumour	59	11.6	1.8	4.6	0.5
	b. Astrocytoma	203	40.0	1.0	6.4	1.7
	c. Intracranial and intraspinal embryonal tumour	85	16.7	1.4	6.1	0.7
	d. Other gliomas	74	14.6	0.8	7.5	0.6
	e. Other specified intracranial and intraspinal neoplasms	75	14.8	1.3	9.7	0.6
	f. Uspecified intracranial and intraspinal neoplasms	11	2.2	2.7	2.7	0.1
IV	**Neuroblastoma and other peripheral nervous cell tumours**	**142**	**6.7**	**1.3**	**1.6**	**1.2**
	a. Neuroblastoma and ganglioneuroblastoma	140	98.6	1.3	1.6	1.1
	b. Other peripheral nervous cell tumours	2	1.4	NA	10.3	0.0
V	**Retinoblastoma**	**48**	**2.3**	**1.1**	**0.9**	**0.4**
VI	**Renal tumours**	**99**	**4.7**	**1.0**	**3.2**	**0.8**
	a. Nephroblastoma and other nonepithelial renal tumours	96	97.0	1.0	3.2	0.8
	b. Renal carcinomas	3	3.0	2.0	8.5	0.0
	c. Unspecified malignant renal tumours	0	NA	NA	NA	NA
VII	**Hepatic tumours**	**21**	**1.0**	**2.5**	**2.1**	**0.2**
	a. Hepatoblastomas	18	85.7	2.6	2.1	0.1
	b. Hepatic carcinomas	3	14.3	2.0	8.9	0.0
	c. Unspecified malignant hepatic tumours	0	NA	NA	NA	NA

Table 5 Continued

	Diagnosis	n	Relative frequency	Sex ratio (male:female)	Age at Dx (Median)	Incidence*
VIII	**Malignant bone tumours**	**80**	**3.8**	**0.8**	**11.8**	**0.7**
	a. Osteosarcomas	44	55.0	0.9	11.8	0.4
	b. Chondrosarcomas	2	2.5	1.0	12.7	0.0
	c. Ewing tumour and related sarcomas of bone	33	41.3	0.8	11.7	0.3
	d. Other specified malignant bone tumours	0	NA	NA	NA	NA
	e. Unspecified malignant bone tumours	2	2.5	1.0	12.7	0.0
IX	**Soft tissue and other extraosseous sarcomas**	**149**	**7.0**	**1.0**	**7.2**	**1.2**
	a. Rhabdomyosarcomas	77	51.7	0.9	4.5	0.6
	b. Fibrosarcomas, peripheral nerve sheath tumours, and other fibrous neoplasms	10	6.7	2.3	9.4	0.1
	c. Kaposi sarcoma	0	NA	NA	NA	NA
	d. Other specified soft tissue sarcomas	47	31.5	0.7	10.6	0.4
	e. Unspecified soft tissue sarcomas	14	9.4	2.5	9.0	0.1
X	**Germ cell tumours, trophoblastic tumours, and neoplasms of gonads**	**68**	**3.2**	**0.9**	**10.0**	**0.6**
	a. Intracranial and intraspinal germ cell tumours	24	35.3	2.0	11.2	0.2
	b. Malignant extracranial and extragonadal germ cell tumours	19	27.9	0.5	0.1	0.2
	c. Malignant gonadal germ cell tumours	24	35.3	0.7	11.8	0.2
	d. Gonadal carcinomas	0	NA	NA	NA	NA
	e. Other and unspecified malignant gonadal tumours	1	1.5	NA	0.8	0.0
XI	**Other malignant epithelial neoplasms and malignant melanomas**	**103**	**4.8**	**0.6**	**12.7**	**0.8**
	a. Adrenocortical carcinomas	4	3.9	0.3	5.1	0.0
	b. Thyroid carcinomas	17	16.5	0.1	13.4	0.1
	c. Nasopharyngeal carcinomas	2	1.9	1.0	13.6	0.0
	d. Malignant melanomas	11	10.7	0.2	13.3	0.1
	e. Skin carcinomas	8	7.8	1.0	12.0	0.1
	f. Other and unspecified carcinomas	63	61.2	0.9	12.6	0.5
XII	**Other and unspecified malignant neoplasms**	**6**	**0.3**	**1.0**	**7.2**	**0.0**
	a. Other specified malignant tumours	3	50.0	0.5	3.6	0.0
	b. Other unspecified malignant tumours	1	16.7	NA	0.0	0.0
Total (not including Langerhans cell histiocytosis)		**2124**	**100.0**	**1.3**	**6.2**	**17.3**
	Langerhans cell histiocytosis	67	3.1	1.7	5.8	0.5
Total (including Langerhans cell histiocytosis)		**2191**	**100.0**	**1.3**	**6.2**	**17.8**

* Incidence: newly diagnosed tumours in a one years time period per 100'000 persons (person-years); NA: not applicable

Swiss residents; age at diagnosis 0-14 years, period of diagnosis 2009-2018, all diagnoses (ICCC-3 or Langerhans cell histiocytosis); N=2191

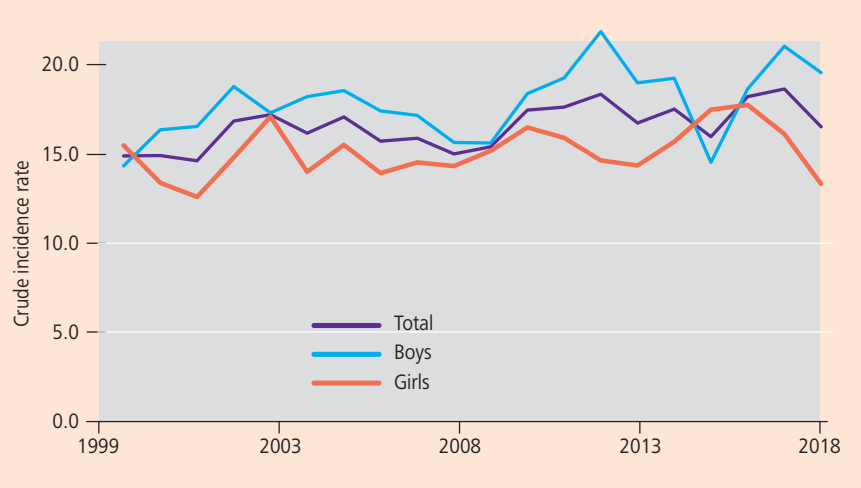


Figure 5
Crude incidence rate (per 100'000 person-years) in Switzerland, by sex and year of diagnosis for the last 20 years (1999-2018)

Swiss residents; age at diagnosis 0-14 years; period of diagnosis 1999-2018; all diagnoses (ICCC-3 but not including Langerhans cell histiocytosis); N=4039

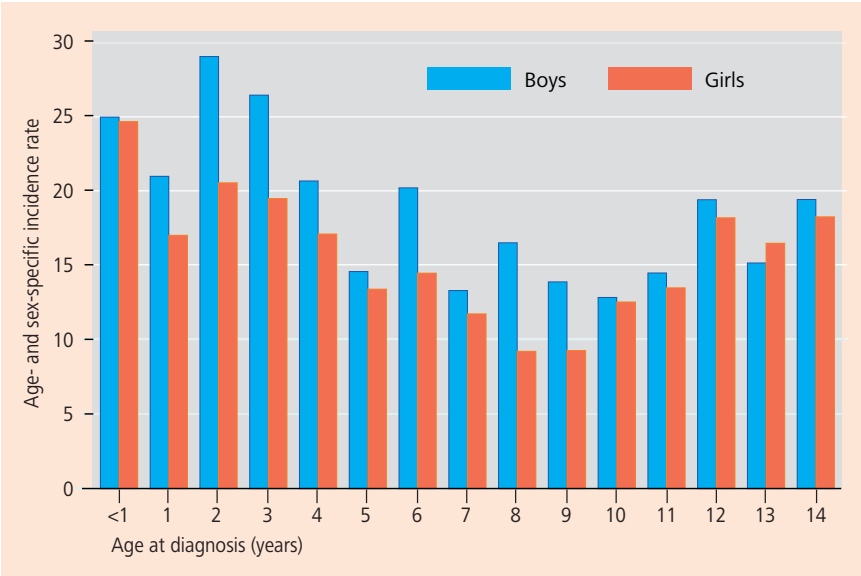


Figure 6
Age- and sex-specific incidence rates (per 100'000 person-years) in Switzerland for the last 10 years

Swiss residents; age at diagnosis 0-14 years; period of diagnosis 2009-2018; all diagnoses (ICCC-3 but not including Langerhans cell histiocytosis); N=2124

3.4 Swiss residents aged 15-20 years at diagnosis (N=940)

Table 6 describes the tumours registered in the last ten years (2009-2018) diagnosed in adolescent patients (aged 15-20 years at diagnosis, N=940). Because data on adolescents are currently not complete within the SCCR, we do not present incidence rates. In adolescents the sex ratio is closer to 1 than in those aged 0-14 years at diagnosis.

Table 6
Adolescent cancer diagnosed in Switzerland 2009-2018: number of cases, relative frequency, sex ratio, and median age at diagnosis by diagnostic groups according to ICCC-3

	Diagnosis	n	Relative frequency	Sex ratio (male:female)	Age at Dx (Median)
I	**Leukaemias, myeloproliferative diseases, and myelodysplastic diseases**	**102**	**10.9**	**1.2**	**17.2**
	a. Lymphoid leukaemias	52	51.0	1.6	16.8
	b. Acute myeloid leukaemias	25	24.5	0.9	17.7
	c. Chronic myeloproliferative diseases	14	13.7	0.8	18.1
	d. Myelodysplastic syndrome and other myeloproliferative diseases	10	9.8	1.0	16.4
	e. Unspecified and other specified leukaemias	1	1.0	NA	15.1
II	**Lymphomas and reticuloendothelial neoplasms**	**223**	**23.8**	**1.3**	**17.7**
	a. Hodgkin lymphomas	147	65.9	1.2	17.6
	b. Non-Hodgkin lymphomas (except Burkitt lymphoma)	62	27.8	1.4	17.8
	c. Burkitt lymphoma	12	5.4	5.0	17.8
	d. Miscellaneous lymphoreticular neoplasms	1	0.4	NA	20.0
	e. Unspecified lymphomas	1	0.4	NA	15.3
III	**CNS and miscellaneous intracranial and intraspinal neoplasms**	**124**	**13.2**	**1.3**	**17.5**
	a. Ependymomas and choroid plexus tumour	14	11.3	6.0	19.4
	b. Astrocytoma	37	29.8	0.9	18.1
	c. Intracranial and intraspinal embryonal tumours	19	15.3	1.4	16.8
	d. Other gliomas	18	14.5	0.5	17.3
	e. Other specified intracranial and intraspinal neoplasms	33	26.6	1.5	17.3
	f. Uspecified intracranial and intraspinal neoplasms	3	2.4	2.0	16.9
IV	**Neuroblastoma and other peripheral nervous cell tumours**	**5**	**0.5**	**0.7**	**18.5**
	a. Neuroblastoma and ganglioneuroblastoma	1	20.0	NA	16.3
	b. Other peripheral nervous cell tumours	4	80.0	1.0	19.2
V	**Retinoblastoma**	**0**	**NA**	**NA**	**NA**
VI	**Renal tumours**	**4**	**0.4**	**3.0**	**16.4**
	a. Nephroblastoma and other nonepithelial renal tumours	1	25.0	NA	16.4
	b. Renal carcinomas	3	75.0	2.0	16.4
	c. Unspecified malignant renal tumours	0	NA	NA	NA
VII	**Hepatic tumours**	**2**	**0.2**	**2.0**	**18.5**
	a. Hepatoblastomas	0	NA	NA	NA
	b. Hepatic carcinomas	2	100.0	2.0	18.5
	c. Unspecified malignant hepatic tumours	0	NA	NA	NA
VIII	**Malignant bone tumours**	**65**	**6.9**	**1.6**	**16.7**
	a. Osteosarcomas	40	61.5	1.4	16.7
	b. Chondrosarcomas	7	10.8	6.0	19.8
	c. Ewing tumour and related sarcomas of bone	18	27.7	1.6	16.4
	d. Other specified malignant bone tumours	1	1.5	NA	17.4
	e. Unspecified malignant bone tumours	0	NA	NA	NA

Table 6 Continued

	Diagnosis	n	Relative frequency	Sex ratio (male:female)	Age at Dx (Median)
IX	**Soft tissue and other extraosseous sarcomas**	**69**	**7.4**	**1.6**	**17.7**
	a. Rhabdomyosarcomas	15	21.7	1.5	17.5
	b. Fibrosarcomas, peripheral nerve sheath tumours, and other fibrous neoplasms	14	20.3	2.5	16.6
	c. Kaposi sarcoma	0	NA	NA	NA
	d. Other specified soft tissue sarcomas	32	46.4	1.5	18.4
	e. Unspecified soft tissue sarcomas	8	11.6	1.0	17.5
X	**Germ cell tumours, trophoblastic tumours, and neoplasms of gonads**	**118**	**12.6**	**4.1**	**18.7**
	a. Intracranial and intraspinal germ cell tumours	10	8.5	10.0	17.0
	b. Malignant extracranial and extragonadal germ cell tumours	1	0.8	NA	20.9
	c. Malignant gonadal germ cell tumours	98	83.1	5.1	18.9
	d. Gonadal carcinomas	7	5.9	0.2	19.0
	e. Other and unspecified malignant gonadal tumour	2	1.7	1.0	17.9
XI	**Other malignant epithelial neoplasms and malignant melanomas**	**219**	**23.4**	**0.5**	**18.5**
	a. Adrenocortical carcinomas	1	0.5	NA	15.1
	b. Thyroid carcinomas	60	27.4	0.3	17.7
	c. Nasopharyngeal carcinomas	4	1.8	3.0	20.0
	d. Malignant melanomas	52	23.7	0.9	19.0
	e. Skin carcinomas	16	7.3	1.0	19.0
	f. Other and unspecified carcinomas	85	38.8	0.4	18.4
XII	**Other and unspecified malignant neoplasms**	**5**	**0.5**	**1.5**	**17.4**
	a. Other specified malignant tumours	5	100.0	1.5	17.4
	b. Other unspecified malignant tumours	0	NA	NA	NA
Total (not including Langerhans cell histiocytosis)		**936**	**100**	**1.2**	**17.8**
Langerhans cell histiocytosis		4	0.4	1.0	17.8
Total (including Langerhans cell histiocytosis)		**940**	**100**	**1.2**	**17.8**

Swiss residents; age at diagnosis 15-20 years, period of diagnosis 2009-2018, all diagnoses (ICCC-3 or Langerhans cell histiocytosis); N=940

4. Research on childhood cancer

The research of the childhood cancer registry focusses on two main topics: Aetiology of childhood cancer and longterm outcomes and follow-up care. These topics are described with their background, aims, methods, recent findings, ongoing studies, and contacts in the remainder of **Chapter 4**. Additional information is available from the investigators and our website (www.childhoodcancerregistry.ch). Further, we thank the supporters for their generous contributions towards the research projects.

All previous and ongoing studies, their funding sources, and the senior investigator are summarized in **Table 7**.

Table 7
Research grants of the SCCR, summary

No	Project name	Senior investigator	Funding sources	Study period
Aetiology of childhood cancer				
1	Low dose ionising radiation and the risk of childhood cancer	Spycher BD	Swiss National Science Foundation (SNF 320030_176218/1)	10.2017-09.2021
2	Residential and occupational exposure to UV radiation and haematological malignancies	Spycher BD	Swiss Cancer Research (KLS-4592-08-2018)	01.2019-12.2021
3	Spatial variation of childhood cancer risk in Switzerland and associations with traffic-related air pollution	Spycher BD	Swiss Cancer Research (KFS-4012-08-2016)	01.2017-12.2018
4	Spatial and spatio-temporal clustering of childhood cancer: The role of infections and environmental hazards	Spycher BD	Swiss Cancer Research (KFS-3515-08-2014)	01.2014-12.2016
5	The spatial epidemiology of childhood cancer in Switzerland	Spycher BD	Swiss Cancer Research (KFS-3515-08-2014)	01.2014-12.2016
6	The role of population mixing and exposure to infections in the aetiology of childhood leukaemia: a national cohort study	Spycher BD	Swiss Cancer Research (KFS-3049-08-2012)	01.2013-12.2014
7	Childhood cancer and geographically defined exposures in Switzerland: a census-based nationwide cohort study	Spycher BD	Federal Office of Public Health (12.008357)	03.2013-11.2013
8	Childhood cancer and vicinity of residence to petrol stations and roads: census-based nationwide cohort study (PETROL)	Kuehni CE	Federal Office of Public Health (10.002946)	06.2010-02.2013
9	Childhood cancer and nuclear power plants in Switzerland: A census-based cohort study	Kuehni CE	Swiss Cancer League (02224-03-2008); Federal Office of Public Health (08.001616)	09.2008-02.2011
Outcome research (Long-term outcomes, follow-up care, international collaboration)				
1	Swiss Childhood Cancer Survivor Study (SCCSS)	Kuehni CE Kuehni CE Kuehni CE, Angst R Kuehni CE, Bergstraesser E Kuehni CE Von der Weid NX, Kuehni CE Von der Weid NX, Kuehni CE	Kinderkrebshilfe Schweiz Stiftung zur Krebsbekämpfung Cancer League Aarau Cancer League Zurich Cancer League Bern Swiss Cancer League (KLS-2215-02-2008) Swiss Cancer League (KLS-1605-10-2004)	01.2006-12.2018 01.2017-12.2017 01.2012-12.2012 08.2010-07.2011 04.2009-03.2010 07.2008-06.2010 01.2006-10.2008
2	Pulmonary dysfunction after childhood cancer: diagnosing cearly stage disease	Kuehni CE	Swiss Cancer Research (KFS-4157-02-2017)	09.2017-08.2020
3	PanCare Studies in Fertility and Ototoxicity to improve Quality of Life after Cancer during Childhood, Adolescence and Young Adulthood (PanCareLIFE)	Kuehni CE Kuehni CE	EU (FP7-HEALTH-F2-2013- 602030) Swiss Cancer League (KLS-3412-02-2014)	11.2013-10.2018 07.2014-06.2017
4	PanCare childhood and adolescent cancer survivor care and follow-up studies (PanCareSurFup)	Kuehni CE Kuehni CE	EU (FP7-HEALTH-F2-2010-257505) Swiss Cancer Research (KFS-02783-02-2011)	02.2011-01.2017 08.2011-07.2014
5	Mortality after cancer in childhood and adolescence	Kuehni CE Kuehni CE	Swiss National Science Foundation (PDFMP3_141775) Swiss Bridge	08.2012-08.2015 07.2012-07.2014
6	The Swiss Pediatric Hematology/Oncology Metabank – a network for precision medicine research	Bourquin JP, Kuehni CE, Ansari M	Swiss National Science Foundation (31BL30_185396)	04.2019-03.2021

No	Project name (continued)	Senior investigator	Funding sources	Study period
7	Cardiovascular disease after childhood cancer: diagnosing early stage disease	Von der Weid NX, Kuehni CE	Swiss Cancer League (KLS-3886-02-2016)	01.2017-12.2019
8	Dietary habits, nutrition and risk of late effects after childhood cancer	Bochud M, Kuehni CE	Swiss Cancer League (KLS-3644-02-2015)	07.2015-06.2018
9	Dietary intake, overweight, and late effects development in childhood cancer survivors	Bochud M, Kuehni CE	Swiss Cancer Research (KFS-4722-02-2019)	07.2019-06.2022
10	Risk of cancer and long-term mortality in children treated with growth hormone: Swiss participation in the EU FP7 project (SAGhE)	Mullis P Mullis P, Kuehni CE Mullis P, Kuehni CE	EU (FP-HEALTH-F2-2009-223497) Swiss Cancer League (KLS-2948-02-2012) Swiss Cancer League (KLS-02586-02-2010)	04.2011-03.2014 07.2012-12.2013 07.2010-12.2012
11	Lung problems after childhood cancer: Implementation of a structured follow-up care in Switzerland	Sommer G	Kinderkrebs Schweiz	06.2017-05.2018
12	Pulmonary late-effects in long-term childhood cancer survivors – Development of guidelines for follow-up care	Sommer G, Goutaki M	Cancer League Bern Lung League Bern	01.2017-02.2018
13	Improving follow-up care of childhood cancer: implementation of screening for psychological distress	Michel G, Scheinemann K	Swiss Cancer Research (KFS-3955-08-2016)	04.2017-03.2020
14	PanCareFollowUp: Novel, patient-centred survivorship care to improve care quality, effectiveness, cost-effectiveness and accessibility for survivors and caregivers	Michel G	Horizon 2020 (SEP-210494581)	01.2019-12.2023
15	Grandparents' involvement and psychosocial outcomes when a grandchild is diagnosed with cancer: acute and long-term consequences	Michel G	Swiss National Science Foundation (10001C_182129/1)	01.2019-12.2022
16	Needs for psychosocial care after childhood cancer – A mixed methods study	Michel G	Swiss Cancer Research (HSR-4080-11-2016)	06.2017-05.2019
17	Psychological late effects in long-term childhood cancer survivors – Development of guidelines for follow-up care	Michel G	Krebsliga Zentralschweiz	11.2015-10.2017
18	Follow-up care after childhood and young adult cancer (CCFU)	Michel G	Swiss National Science Foundation (PZ00P3_121682 and PZ00P3_141722)	08.2009-08.2014
19	Effectiveness of transition from paediatric to adult care after childhood cancer	Michel G	Swiss Cancer League (KFS-02631-08-2010)	04.2011-04.2014
20	Parents of long-term childhood cancer survivors	Michel G	Swiss National Science Foundation (100019_153268/1) Kinderkrebshilfe Schweiz	since 2013
21	Fertility after Chemo- and Radiotherapy in Childhood and Adolescence, FeCt – Multicentre	Michel G	Kinderkrebshilfe Schweiz	since 2012

4.1 Aetiology of childhood cancer

Background

The aetiology of childhood cancers remains largely unknown. For leukaemia, the most frequent childhood cancer, known risk factors include trisomy 21, certain rare genetic syndromes, some common germline genetic variants, high birthweight, and high parental age at birth. Regarding environmental exposures, only ionising radiation at medium to high doses is an established risk factor – both for leukaemia and CNS tumours. Numerous other environmental factors are being discussed as potential risk factors. These include: low dose ionising radiation (e.g. natural background radiation and diagnostic radiation), traffic related air pollution, electromagnetic fields (e.g. from power lines, radio and TV transmitters, or mobile phones) pesticides, and infections.

Aims

The broad aims of the group are to investigate:

- Whether cancer risks in children are associated with environmental exposures, such as ionising and non-ionising radiation, air pollution, and UV exposure, as well as parents workplace exposures;
- Whether cancer risks in children are associated with socio-economic, family or perinatal exposures;
- The spatial and spatio-temporal distribution of childhood cancer cases in order to identify potential environmental risk factors.

Methods

Clinical and residential information on diagnosed cases are obtained from the SCCR. Data on the population at risk are obtained from the Swiss National Cohort (SNC) which includes the entire Swiss resident population at census time points (1990, 2000, and annually from 2010 onward). Record linkage between the two datasets allows investigating cancer incidence on a nationwide scale with a cohort design. The SCCR collects geocoded address histories from birth to diagnosis allowing to distinguish different exposure time windows. Geocoded places of residence are also available for the entire population from the SNC. This allows calculating geographically determined exposures such as distance to highways or NO_2 concentration levels (based on spatial pollution models) for the entire population at risk. The SNC also provides demographic, socioeconomic and perinatal data for the entire population. The availability of precise geocodes of residence allows investigating spatial and spatio-temporal clustering or identifying areas of higher risk (disease mapping) using methods for point pattern data rather than methods for less precise regional count data (e.g. aggregated at municipality level).

Current status

A, Recent findings: A summary of our recent research and findings is given in [Lupatsch-2016a]. We found evidence of increased risks of childhood leukaemia and CNS tumours among children exposed to higher levels of natural background radiation (terrestrial gamma and cosmic radiation) [Spycher-2015a, 2015b, 2015c]. Young children living in the immediate proximity (<100m) of highways were found to have an increased leukaemia risk [Spycher-2015d]. We found little evidence of associations between childhood leukaemia and commonly used measures of population mixing [Lupatsch-2015b, c] or for associations between leukaemia risk and socioeconomic status [Adam-2015]. However, we did find evidence of a temporal association between childhood leukaemia and periods of rapid population growth in Swiss municipalities [Lupatsch-2016d]. We found evidence for spatio-temporal clustering of leukaemia around the time of birth but not around the time of diagnosis [Kreis-2016] and this clustering was associated with the TEL-AML1 (ETV6-RUNX1) cytogenetic subtype [Kreis-2017]. In contrast, we found little evidence of purely spatial clustering for childhood leukaemia [Konstantinoudis-2017], but some evidence for embryonal CNS tumours and Hodgkin lymphoma [Konstantinoudis-2018]. In an international pooled analysis we found a small but imprecise risk for proximity to powerlines and childhood leukaemia that was not explained by high magnetic fields [Amoon-2018]. In a recent systematic review, we found evidence of space-time clustering of childhood leukaemia around time of diagnosis among children aged 0-5 years [Kreis-2019].

B, Ongoing studies: In ongoing studies we are investigating whether: i) childhood cancer is associated with increased air concentrations of benzene and NO_2; ii) childhood leukaemia is associated with perinatal characteristics (including parental age, birth order, age difference to next older sibling, and birth weight); iii) there are specific areas of increased risk of childhood cancers in Switzerland (disease mapping); and iv) the role of UV exposure with respect to haematological malignancies. v) We are also conducting a nationwide survey complemented with dosimetry measurements to retrieve precise estimates of exposure to background radiation. This information coupled with the background radiation statistical models we are developing will be used to assess association between background radiation and childhood cancer risk. Furthermore, we are vi) collaborating in an international case control study on the association between childhood cancer and proximity to transformers.

Contact

The research team consists of Ben Spycher, Claudia Kuehni, Christian Kreis, Astrid Coste, Garyfallos Konstantinoudis, Christophe Folly, and Antonella Mazzei.

4.2 Long-term outcomes

Background

Childhood cancer is the most common disease-related cause of death in children in developed countries. Survival rates for childhood cancer now exceed 80% thanks to therapeutic improvements in the past decades [Schindler-2017], leading to a growing population of long-term survivors. However, cancer and its treatment can cause late effects, such as secondary neoplasms, heart and lung diseases, hearing loss, and infertility. Late effects may have an impact on survivors' health, health behaviour and quality of life, and may lead to premature death. Comprehensive data on the burden of late effects of childhood cancer including premature mortality and their risk factors are scarce. The SCCR has a broad research program focusing on long-term outcomes including the national Swiss Childhood Cancer Survivor Study (SCCSS), prospective, clinical studies on lung and cardiovascular diseases, and a study on cause-specific long-term mortality.

Aims

The research group aims to:

- Investigate prevalence, incidence and spectrum of somatic and psychosocial outcomes including, somatic health, mental health, educational and social outcomes, health-related quality of life, secondary neoplasms, and cause-specific long-term mortality.
- Determine sociodemographic, cancer- and treatment related predictors associated with long-term outcomes.
- Describe health behaviours, and
- Investigate and improve follow-up care in childhood cancer survivors.

Methods

Study population: Eligible are all individuals, who have been diagnosed with cancer at age <21 years, who survived at least five years, were alive at the time of the study, and who were Swiss residents at time of diagnosis.

Collected data: We sent a detailed questionnaire to childhood cancer survivors and their parents to obtain data about somatic, psychosocial, lifestyle, and mental health outcomes. For comparison, we sent the same questionnaire excluding cancer-related questions to siblings of survivors. We complete and validate questionnaire data with phone interviews with patients, information from general practitioners, and hospital records, e.g. audiometric or lung function tests to validate hearing problems or lung diseases. We sent a second questionnaire to participating survivors to find out whether their health changes over time. We invite subgroups of survivors to paediatric oncology centres for clinical investigations to assess their lung and heart functions and we collect saliva and urine samples for genetic and metabolic analyses. Additionally, we gather data from municipal population registries to obtain vital status and date of death, and from Swiss mortality statistics to obtain causes of death. This broad approach makes it possible to investigate prevalence and incidence of late effects and causes of death in Swiss survivors and to identify predictors for their occurrence.

Response rate: For the SCCSS questionnaire survey, we contacted 4689 five-years survivors aged 0-<20 years at diagnosis, 3177 (68%) completed our questionnaire. Among the participating survivors, we contacted 1599 survivors with a second questionnaire, of whom 919 (57%) responded. We also contacted 1530 siblings of childhood cancer survivors, of which 866 (57%) participated.

Current status

A, Recent findings

These ongoing studies provide national data on late effects, health behaviour, survival and long-term mortality, and causes of death after childhood and adolescence cancer in Switzerland. We analyse data and publish our findings continuously. Previous publications reported on health-related quality of life, education, cognitive problems, partnership, income, physical activity, lung disease, cardiovascular disease, hearing loss, nutrition, overweight, survival, and mortality. Our findings help to identify patients who are at risk for late effects, to adjust therapies, and to develop tailored follow-up programs for survivors.

Health-related quality of life (HRQoL): We found that the overall HRQoL of young survivors (8-16 years) was comparable to population norms for most parent- reported dimensions and higher for most self-reported dimensions [Wengenroth-2015]. However, older survivors (>16 years) had lower HRQoL than their siblings, and among survivors, those with chronic health problems had the lowest health-related quality of life [Rueegg-2013]. Even after a relapse, survivors of acute lymphoblastic leukemia reported a good HRQoL [Essig-2012].

Educational and social outcomes: We showed that survivors achieved educational levels similar to the general population [Kuehni-2012]. Survivors younger than 20 years were more likely to report cognitive problems than their siblings [Wengenroth-2015]. We found lower personal income in survivors than in siblings [Wengenroth-2016]. However, survivors' personal income may increase later because treatment can push back education and carreer training and cause survivors to start working later than their peers. Survivors are less likely than peers to be married or be in a life partnership [Wengenroth-2014]. Since survivors take longer to reach their final educational achievement than the general population [Kuehni-2012], this might encourage survivors to delay marriage.

Physical activity: We found that daily physical activity and sport levels in survivors were similar to the general population. Physical activity was mainly determined by socio-demographic and cultural factors [Rueegg-2012a]. However, we found that survivors are at high risk of suffering from performance limitations in sports and daily living activities but these limitations differed strongly between diagnostic groups [Rueegg-2012b]. Despite these physical performance limitations, many survivors maintained healthy activity levels [Rueegg-2013].

Lung disease: Survivors are at increased risk of pneumonia, independent of treatment era. [Kasteler-2018b]. The number of survivors suffering from a pulmonary disease increases with time after end of treatment. Therefore, long-term clinical monitoring of pulmonary health is necessary. But our results also show, that not all survivors exposed to lung toxic treatment modalities are followed up with pulmonary function tests in Switzerland [Kasteler-2018a]. The harmful effect of smoking to the lung can increase by the preceding lung toxic treatment. Despite this, we found that survivors who had lung toxic treatment did not smoke less than those who had not received such treatment. Overall survivors smoke as often as their siblings but less than the general population [Kasteler-2019].

Cardiovascular disease: Survivors of acute lymphoblastic leukemia are at increased risk for cardiovascular disease compared to their sibings with the highest risk for heart failure. We found no risk reduction over time for cardiovascular disease, despite attempts to reduce cardiotoxicity of cancer treatment during past decades [Hau-2019]

Hearing loss: We found that the burden of hearing loss as a late effect after ototoxic cancer treatment has stabilized in recently treated survivors, suggesting that survivors have benefited from new treatment regimens that use less ototoxic radiation and carefully dosed platinum compounds [Weiss-2017]. We also found that questionnaires are useful to assess hearing in large cohorts of childhood cancer survivors, but they underestimate mild and unilateral hearing loss. [Weiss-2017]. Hearing loss reduces physical well-being and impairs relationships with peers in survivors of CNS tumours, but not in other survivors [Weiss-2019]. Survivors may benefit from audiological monitoring, but guidelines are insufficiently followed in Switzerland, particularly when patients neither are participants in a study nor treated according to a specific cancer study protocol [Weiss-2018].

Nutrition: We showed that young adults, who had cancer in childhood adhere poorly to national dietary recommendations [Belle-2017]. We assessed dietary intake by a food frequency questionnaire and found that intake is similarly poor in Swiss childhood cancer survivors as in peers [Belle-2019b].

Overweight: We found that childhood cancer survivors in Switzerland are not more likely to become overweight than peers who had not had cancer [Belle-2018a, 2018b]. Cranial radiation leads to overweight that persists many years after diagnosis [Belle-2018b], but corticosteroid treatment is unlikely to lead to overweight in the long-term [Belle-2018a]. Leukaemia and lymphoma patients gained considerable weight during the duration of cancer treatment [Belle-2019a].

Survival: We found that five-year survival of children diagnosed with cancer in Switzerland improved from 64% in 1976-1983 to 88% in 2004-2013, but there is room for further improvement. Survival rates varied by type of clinical treatment, language region, and nationality. To improve survival, all paediatric cancer patients should be referred to a specialised paediatric cancer centre [Schindler-2017].

Mortality: We found that five-year survivors of childhood cancers suffer from an elevated mortality compared to the general population, with recurrence and progression of the original cancer as the most common causes of death up to 24 years after diagnosis [Schindler-2016].

B, Ongoing studies

Ongoing studies focus on different somatic health problems and health behaviours: i) lung diseases; ii) cardiovascular diseases; iii) secondary neoplasms; and iv) dietary habits and overweight. We are currently setting up the collection of germline DNA of all childhood cancer patients and survivors to allow research in cancer genetics. This germline DNA collection project is led jointly with the Children's Hospitals in Zurich and Geneva under the «BioLink» research funding programme of the Swiss National Science Foundation. This project entitled «The Swiss Paediatric Haematology/Oncology Metabank» will link data from the SCCR with data from various biobanks. It aims to expand the already extensive data in the SCCR to include genetic and tumour information. The data in the biobanks on hereditary factors of the patients and their tumours, together with the clinical data, will enable in-depth research in the fields of cancer predispositions, pharmacogenetics, and genetic modifiers of long-term complications. This is an important step towards carrying out research in Switzerland to personalise childhood cancer treatment and aftercare. Furthermore, we collaborate in international studies (see International collaborations).

Contact

The research team consists of Claudia Kuehni, Fabiën Belle, Maria Otth, Christina Schindera, Grit Sommer, Nicolas Waespe, and Nicolas von der Weid.

4.3 International collaborations

Background

Late effects of childhood cancer and its treatment are common, but numbers in individual countries are low. Therefore, pooling observational data to large international cohorts and using genetic tools to analyse data are essential to identify risk factors. Survivors can benefit from personalized, evidence-based care grounded on their individual risk; and future patients may benefit from adapted treatment, that cause less severe side effects.

International studies on childhood cancer often include systematic reviews that summarize the evidence of risk factors on late effects. These provide the basis for creating new guidelines for the clinical long-term follow-up of survivors.

The SCCR collaborates with other childhood cancer cohorts [Bhatia-2015, Winther-2015, Tonorezos-2018], participates in European studies to investigate late effects, and is involved in the development of international guidelines for clinical long-term follow-up of childhood and adolescent cancer survivors.

Aims

Within the international collaborations, we aim to investigate:

- Prevalence and incidence of late effects of childhood and adolescent cancer and its treatment
- Risk factors for these late effects
- Follow-up care

We also aim to develop guidelines to improve the health and quality of life of current and future survivors of childhood cancer.

Methods

Swiss survivors of childhood and adolescence cancer are part of the Pan-European Network for Care of Survivors after Childhood and Adolescent Cancer (PanCare). Researchers within this European collaboration can select survivors with late effects for nested case-control or case-cohort studies, for example survivors with secondary neoplasms, cardiovascular or hearing problems. Within these studies, researchers can identify non-genetic and genetic risk factors of late effects.

Experts and the International Guideline Harmonization Group (IGHG, http://www.ighg.org/) write systematic reviews to develop evidence-based, standardised guidelines for clinical follow-up of survivors.

Current status

A, Ongoing studies:

Currently, we are collaborating in two ongoing studies:

PanCareSurFup (PanCare childhood and adolescent cancer survivor care and follow-up studies; http://www.pancaresurfup.eu/)

This project investigates the burden and risk factors of the most severe and life threatening late effects, namely secondary neoplasms, cardiovascular disease, and premature death. We contributed with 4719 Swiss five-year survivors to the Pan-European cohort and with detailed treatment data from medical records of 139 Swiss survivors to the European nested-case control studies.

Recent findings: PanCareSurFup published several articles [Feijen-2014, Terenziani-2014, Brown-2015, Hjorth-2015, Winther-2015, Mulder-2016, Feijen-2016, Bright-2017, Fidler-2018, Grabow-2018, Byrne-2018] and more are in preparation.

PanCareLIFE (PanCare Studies in Fertility and Ototoxicity to Improve Quality of Life after Cancer during Childhood, Adolescence and Young Adulthood; http://www.pancarelife.eu/) This project investigates hearing loss, infertility and quality of life. We identified 304 survivors at risk for hearing loss and collected their hearing tests. Among the 304 survivors, we contacted 221 survivors for the collection of saliva samples and153 survivors provided their saliva sample for the analysis of genetic risk factors for hearing loss. We contributed with SCCSS questionnaire data from 1585 survivors on hearing loss, fertility, and quality of life. Currently, we are analysing, together with the University of Bonn in Germany, quality of life data and its risk factors from 9871 survivors of five European countries.

Recent findings: The first published articles describe the PanCareLIFE study design [Byrne-2018, van der Kooi-2018, van den Berg-2018, Clemens-2018]. Many more are in preparation.

B, Development of guidelines

In close collaboration with experts worldwide and the International Guideline Harmonization Group (IGHG, http://www.ighg.org/), we write systematic reviews and develop evidence-based, standardized guidelines for clinical follow-up of survivors. We are currently involved as chairs, work group (WG) leaders and group members in the development of the following guidelines:

- ***Hearing loss (ototoxicity)***
  - Chairs: Wendy Landier (USA), Richard Cohn (AUS)
  - WG leaders: Claudia Kuehni (CH), Thorsten Langer (DE)
- ***Pulmonary dysfunction***
  - Chairs and WG leaders: Claudia Kuehni (CH), Andrew Dietz (USA)
- ***Fatigue, mental health and psychosocial problems***
  - Chairs: Gisela Michel (CH), Jordan Gilleland Marchak (USA)
  - Fatigue WG leaders: Kathrin Scheinemann (CH), Gisela Michel (CH)
  - Mental Health WG leaders: Janine Vetsch (CH), Jordan Gilleland Marchak (USA)
  - Psychosocial WG leaders: Katie Devine (USA), Martha Grootenhuis (NL)
- ***Metabolic syndrome-Obesity***
  - Obesity WG leaders: Kevin Oeffinger (USA), Emily Tonorezos (USA)
- ***Hypothalamic-Pituitary disorders***
  - Chairs: Hanneke van Santen (NL), Wassim Chemaitilly (US)

Recent findings: A survey among paediatric oncology/haematology clinics from 44 European countries found that many clinics have insufficient or lack programmes for long-term follow-up into adulthood for survivors of childhood cancer [Brown-2015]. This study showed that available guidelines are not universally used throughout Europe and we need to further develop and disseminate Pan-European long-term follow-up

guidelines. Recommendations for ototoxicity surveillance for childhood, adolescent, and young adult cancer survivors within IGHG are recently published [Clemens-2019].

4.4 Psychosocial outcomes and follow-up care

Background

Treatment for cancer in children, adolescents and young adults has improved remarkably and most patients can be cured today. However, more than 50% of survivors of childhood cancer suffer from late effects. To detect and treat late effects as early as possible, most survivors should continue to attend follow-up care long after their cancer has been cured. Follow-up care needs to be constantly updated to meet the current status of research. International guidelines summarising the care needed after different cancers and treatment are necessary. Additionally, while various models of follow-up care have been described, so far none has been implemented in Switzerland. A successful model must not only take clinical aspect into account but also survivors' preferences and needs. A childhood cancer diagnosis does not only affect the child, but the whole family system. Parents might be affected long after their child has been cured. However, there is lack of research on how parents of childhood cancer are doing in the very long-term.

Aims

The group aims to:

- Describe follow-up care models available across Europe, and preferences for a follow-up model among Swiss childhood, adolescent and young adult cancer survivors, parents and physicians (oncologists and general practitioners)
- Evaluate the transition/transfer from paediatric to adult care in survivors of childhood cancer
- Develop guidelines on psychosocial aspects of follow-up care
- Describe psychological and socio-economic outcomes, as well as needs in survivors of childhood, adolescent and young adult cancer and their family (with a focus on parents of very long-term survivors and grandparents)

Methods

To describe follow-up care models in Europe, we invited 198 clinics and follow-up programmes in Europe to complete a questionnaire survey describing the follow-up care available at their institution. To assess preferences for different models of follow-up care, a questionnaire survey assessed opinions and perspectives on both currently used and desired optimal follow-up care among survivors, parents, paediatric and adult oncologists/haematologists and family practitioners. We evaluated the transition from paediatric to adults among childhood cancer survivors using medical records. Guidelines are being developed in collaboration with the IGHG. Furthermore, we contacted parents of childhood cancer survivors in a questionnaire survey to assess positive and negative psychological, familial, and socio-economic outcomes. These outcomes are compared to the Swiss general population.

Current status

A, Recent Findings:

Follow-up care: Our survey among European paediatric oncology/haematology clinics found that many still are lacking programmes for long-term follow-up into adulthood [Essig-2012, Brown-2015]. Additionally, a large proportion of Swiss survivors do not attend regular follow-up care [Michel-2011, Rebholz-2011, Lupatsch-2016e]. We found supportive subjective norms being associated with the intention to attend follow-up care and the intention being associated with actual attendance of follow-up care in childhood as well as adolescent and young adult cancer survivors [Baenziger-2018, Roser-2018]. Furthermore, in adolescent and young adult cancer survivors, also positive attitudes towards follow-up care were associated with the intention to attend follow-up care [Roser-2018]. Survivors and their parents desire precise information on late effects and follow-up care [Gianinazzi-2014a, Vetsch-2015, 2017b]. Most survivors and parents reported preferences for care by a specialist (oncologist) [Vetsch-2016, Christen-2016, Vetsch-2017, 2018].

Transition: In Switzerland, there is no specialised transition programme for survivors of childhood cancer from paediatric to adult care. We investigated if patients are receiving e.g. follow-up information after release from the paediatric oncology clinic [Gianinazzi-2015]. Patient-adapted information on diagnosis, treatment and future follow-up, provided at the time of discharge, was rarely found. Physicians providing follow-up care reported a need for guidelines and better organisation of transition to adult care (Michel-2017, Essig-2019). Guidelines for transition have been developed (Mulder-2016).

Psychological late effects: We found that both, survivors of childhood as well as adolescent and young adult cancer, are at increased risk for psychological distress [Gianinazzi-2013, Gianinazzi-2014b, Michel-2015, Gianinazzi-2016, Michel-2019] or other negative psychosocial outcomes [Wengenroth-2014, 2015a, 2015b, Kuehni-2012a, Rebholz-2012, Mader-2017a, 2017c, Brinkman-2018]. Survivors of adolescent and young adult cancer reported worse physical health compared to the Swiss general population [Harju-2018]. Male survivors reported better mental health and females slightly worse. The proportions of survivors with poor physical health or poor mental health did not differ from these proportions in the general population.

Parents of long-term childhood cancer survivors: Parents of survivors were less often divorced or separated and more often in a partner relationship compared to parents of the Swiss general population [Mader-2019]. Not being married was not associated with cancer-related characteristics. Parents of survivors reported similar security but higher dependency within the partner relationship compared to parents of the general population.

B, Ongoing studies:

The study on parents of childhood cancer survivors is the first population-based study among parents of long-term survivors of childhood cancer. Data collection has been completed and the upcoming analyses will shed more light on their psy-

chological well-being, socio-demographic outcomes and the needs they have for their children and themselves.

Contact

The research team consists of Gisela Michel, Julia Bänziger, Salome Christen, Manya Hendriks, Anica Ilic, Cristina Priboi, and Katharina Roser in close collaboration with Claudia Kuehni, Katrin Scheinmann, Eva Maria Tinner, and Nicolas von der Weid.

5. Publications of the Swiss Childhood Cancer Registry

All articles published using SCCR data from January 2007 – March 2019 are reported below. Additional publications related to the SCCR or SPOG can be found on the SCCR and SPOG websites: www.childhoodcancerregistry.ch and www.spog.ch.

5.1 Original articles (Peer reviewed journals)

1. Roser K, Mader L, Baenziger J, Sommer G, Kuehni CE, Michel G. Health-related quality of life in Switzerland: normative data for the SF-36 questionnaire. *Quality of Life Research. Accepted for publication.*
2. Michel G, François C, Harju E, Dehler S, Roser K. The long-term impact of cancer: Evaluating psychological distress in adolescent and young adult cancer survivors in Switzerland. *Psycho-Oncology. 2019. doi: 10.1002/pon.4981. [Epub ahead of print].*
3. Essig S, Michel G, Dupont C, Kiss A, Bergstraesser E, Tinner Oehler EM, Kuehni CE. Communicating «cure» to pediatric oncology patients: A mixed methods study. *Pediatr Blood & Cancer. 2019. doi: 10.1002/pbc.27661. [Epub ahead of print]*

2019

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5.2 Editorials, commentaries and author replies (Peer reviewed journals)

2015

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129. Spycher BD, Röösli M, Egger M, Kuehni CE. «Author's Comment on 'Background Ionizing Radiation and the Risk of Childhood Cancer: A Census-Based Nationwide Cohort Study». *Environ Health Perspect. 2015b;123(8):A198-9.*
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2006

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5.3 Reviews (Peer reviewed journals)

2015

133. Bhatia S, Armenian SH, Armstrong GT, van Dulmen-den Broeder E, Hawkins MM, Kremer LC, Kuehni CE, Olsen JH, Robison LL, Hudson MM. Collaborative Research in Childhood Cancer Survivorship: The Current Landscape. *J Clin Oncol. 2015;33(27):3055-64.*
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2014

135. Kuehni C, Spycher BD. Nuclear power plants and childhood leukaemia: lessons from the past and future directions. *Swiss Med Wkly. 2014;144:w13912.*
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2012

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2008

138. Adam M, Rebholz C, Egger M, Zwahlen M, Kuehni CE. Childhood Leukaemia and Socioeconomic Status: what is the evidence? *Radiat Prot Dosim. 2008;132:246-54.*

5.4 Publications (other journals)

Schweizer Krebsbulletin

2016

139. Lupatsch JE, Kreis C, Niggli F, Kuehni CE, Spycher B. 2016. Ursachen von Krebs bei Kindern: Was verrät der Wohnort? *Schweizer Krebsbulletin 2016a;36(01):29-33.*

2014

140. Wengenroth L, Schindler M, Kuonen R, Kuehni CE. Krebs als Kind oder Teenager: das Leben danach. *Schweizer Krebsbulletin 2014;4:292-295.*
141. Michel G, von der Weid NX. Nachsorge nach Krebs im Kindesalter – Pläne für die Schweiz. *Schweizer Krebsbulletin 2014;4:296-298*

2013

142. Rueegg CS, Gianinazzi ME, Michel G. Psychosoziale Spätfolgen nach Kinderkrebs – Eine Langzeitstudie des Schweizer Kinderkrebsregisters. *Schweizer Krebsbulletin. 2013;3,212-213.*
143. Kuehni CE, Mitter V, Niggli F, von der Weid NX. Die Rolle des Kinderkrebsregisters unter dem geplanten Krebsregistrierungsgesetz: Chancen und Risiken. *Schweizer Krebsbulletin 2013;3:213-216.*

2012

144. Niggli F, Kuehni CE, Lamontagne-Müller S. Seltene Krebserkrankungen – das tägliche Brot der pädiatrischen Onkologie. *Schweizer Krebsbulletin. 2012;4.309-10.*
145. Michel G. Nachsorge nach Krebs im Kindesalter. *Schweizer Krebsbulletin. 2012;3:212-213.*

2010

146. Kuehni CE. The Swiss Childhood Cancer Registry: from causes to outcomes. *Schweizer Krebsbulletin. 2010;2:129-130.*

2009

147. Kuehni CE, Feller M, Egger M. Response to: Sufficient statistical power for CANUPIS? *Bulletin suisse du cancer. 2009;4.09:301.*

2008

148. Kuehni CE, von der Weid NX, Hengartner H, Niggli F, Röösli M, Huss A, Feller M, Egger M. CANUPIS – Childhood Cancer and Nuclear Power Plants in Switzerland. *Schweizer Krebsbulletin. 2008;28:264-266.*
149. von der Weid NX, Kuehni CE. Le Registre Suisse du Cancer de l'Enfant: premier Registre du Cancer national. Information de la communauté médicale quant à la nouvelle situation concernant la protection des données. *Bulletin des médecins suisses. 2008;89:117-9.*

Other

2018

150. Michel G, Christen S, Roser K. Nachsorge nach Krebs im Jugend- und jungen Erwachsenenalter. *Schweizer Zeitschrift für Onkologie 2018;2, 22-24.*

2017

151. Michel G. Psychosoziale Bedürfnisse von ehemaligen Kinderkrebspatienten. *Krebsforschung in der Schweiz, Bern, Krebsliga Schweiz 2017;83-86.*

2016

152. Weiss A, Kuehni CE, Michel G, von der Weid NX. 40 Jahre Plattform für Forschung und Monitoring. *Das Schweizer Kinderkrebsregister. info@onkologie. 2016;(05):40-42.*

2013

153. Mitter V, Michel G. Krebs bei Kindern. Ein Überblick aus dem *Schweizer Kinderkrebsregister. Onkologiepflege 1;5-8.*
154. Ruegg CS, Gianinazzi ME, Michel G. Psychosoziale Spätfolgen nach Kinderkrebs – Eine Langzeitstudie des Schweizer Kinderkrebsregisters. *Newsletter Schweizerische Gesellschaft für Psychoonkologie. 21;5-8.*
155. Kuehni CE, Michel G, Egger M, Zwahlen M, Beck Popovic M, Nigglie F, von der Weid NX. Das Schweizer Kinderkrebsregister: Erfahrungen als nationales Krebsregister. *Schweizerische Ärztezeitung 2013;94: 327.*

156. Kuehni CE, Niggli FK. Endlich ein nationales Krebsregistrierungsgesetz für Kinder und Erwachsene. *Schweizerische Ärztezeitung 2013;94:160.*

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157. Michel G. Nachsorge nach Krebs im Kindesalter – ein neues Feld für Pflege?. *Onkologiepflege 2011;3:20-23.*

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158. Kuehni CE, von der Weid NX. Das Schweizer Kinderkrebsregister als erstes nationales Krebsregister: Information der Ärzteschaft zur neuen Datenschutzsituation. *Schweizerische Aerztezeitung. 2008;89:117-9.*

159. Kuehni CE, von der Weid NX. Das Schweizer KinderkrebsregisteralserstesnationalesKrebsregister:InformationderÄrzteschaft zur neuen Datenschutzsituation. *Paediatrica. 2008; 19:53-5.*

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161. Kuehni CE. Children's health and the environment. A global perspective (Book review). *Paediatrica 2007;15:13-28.*

5.5 Reports

Annual Reports SCCR

2017

162. Pfeiffer V, Redmond S, Kuonen R, Sommer G, Spycher BD, Singh P, Michel G, Kuehni CE, The Swiss Childhood Cancer Registry. Annual Report 2015/2016. Berne: Dept. of Social and Preventive Medicine, University of Bern; July 2017.

2016

163. Pfeiffer V, Redmond S, Kuonen R, Sommer G, Schindler M,Singh P, Michel G, Kuehni CE, The Swiss Childhood Cancer Registry. Annual Report 2014/2015. Berne: Dept. of Social and Preventive Medicine, University of Bern; June 2016.

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165. Mitter V, Michel G, Wölfli P, Gianinazzi M, Ruegg CS, Sommer G, Hau E, Kuehni CE, The Swiss Childhood Cancer Registry. Annual Report 2011/2012. Berne: Dept. of Social and Preventive Medicine, University of Bern; Feb 2013.

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166. Mitter V, Michel G, Strippoli MPF, Rebholz CE, Rueegg CS, Viehmann G, Reck M, Niggli F, Hengartner H, von der Weid NX, Kuehni CE. The Swiss Childhood Cancer Registry. Annual Report 2009/2010. Bern: Dept. of Social and Preventive Medicine, University of Bern; April 2011.

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2008

168. Michel G, von der Weid NX, Adam M, Rebholz G, Zwahlen M, Kuehni CE. The Swiss Childhood Cancer Registry. Annual Report 2005/2006. Berne: Dept. Of Social and Preventive Medicine, University of Bern; May 2007.

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169. Kuehni CE, Michel G, Sturdy M, Redmond S, Zwahlen M, von der Weid N. The Swiss Childhood Cancer Registry. Annual Report 2004. Bern: Dept. of Social and Preventive Medicine, University of Bern; December 2005.

Other Reports

2016

170. Arndt V, Feller A, Hauri D, Heusser R, Junker C, Kuehni CE, Lorenz M, Pfeiffer V, Roy E, Schindler M. Schweizerischer Krebsbericht 2015 – Stand der Entwicklungen. Bundesamt für Statistik (BFS); Neuchâtel 2016.

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171. Wyss N, Pury P, Strippoli MPF, Lutz JM, Bouchardy C, Kuehni CE, Junker C. Krebs in der Schweiz – Stand und Entwicklung von 1983 bis 2007. Bundesamt für Statistik (BFS); Neuchâtel 2011.

2005

172. Michel G, Sturdy M, Zwahlen M, Strippoli MPF, von der Weid N, Kuehni CE. Validating date and cause of death information in the Swiss Childhood Cancer Registry against death certificate information from the Swiss Federal Office of Statistics. Bern: Dept. of Social and Preventive Medicine, University of Bern; December 2005.

6. Appendix: Classification of cancer diagnoses

International Classification of Childhood Cancer - ICCC-3

The third edition of the International Classification of Childhood Cancer (ICCC-3) represents the standard for presentation of international data on childhood cancer incidence and survival. It applies the rules, nomenclature and codes (morphology, topography and behaviour) of the ICD-O-3. ICCC-3 categories are defined in conformity with international classifications of the pathology and genetics of childhood cancers. In the ICCC-3, three hierarchical levels have been developed: level one consists of 12 main diagnostic groups and level two of 47 diagnostic subgroups. These two levels of the ICCC-3 allow standardised comparison of the broad categories of childhood tumours. Level three, an optional «extended» classification, comprises two to eleven divisions of selected diagnostic subgroups. The division of some diagnostic subgroups, e.g. leukaemia and Non-Hodgkin lymphomas, reflects the availability of detailed cytogenetic or molecular information that permits homogeneous groups of tumours to be distinguished within them and thus allows their separate study. The Swiss childhood cancer registry (SCCR) uses level one to three. Only malignant neoplasms are classified in ICCC-3, with the exception of non-malignant intracranial and intraspinal tumours. Tumours known to occur only rarely in young patients are also included in ICCC-3. The ICCC-3 is used if data are compared with other childhood cancer registries.

International Statistical Classification of Diseases for Oncology - ICD-O-3

The third edition of the International Statistical Classification of Diseases for Oncology (ICD-O-3) has been developed by a working group hosted by the International Association of Research in Cancer (IARC) and WHO. The morphology code for neoplasm has been revised, especially for lymphomas and leukaemia. In contrast to the International Classification of Diseases, 10th revision (ICD-10), ICD-O-3 uses only one set of four characters for topography (based on the malignant neoplasm section of ICD-10). The topography code remains the same for all neoplasms of that site. The behaviour code is incorporated as the fifth digit in the morphology field. It identifies whether the tumour is malignant, benign, of uncertain or unknown behaviour, in situ, presumed to be primary or secondary. For all tumours diagnosed since 1st January 2014 the SCCR uses the 2011 updates to ICD-O-3 which include new terms, codes and behaviour combinations. This allows e.g. B lymphoblastic leukaemias to be further classified according to their exact cytogenetic and molecular characteristics, which are relevant for disease prognosis. ICD-O-3 is used to compare data with general cancer registries.

International Statistical Classification of Diseases and Related Health Problems - ICD-10

The International Statistical Classification of Diseases and Related Health Problems (ICD) permits the systematic recording, analysis, interpretation and comparison of mortality and morbidity data collected in different regions and at different time periods. The ICD has become the international standard diagnostic classification for all general epidemiological purposes. The ICD-10 classification comprises three volumes: Volume 1 contains the main classifications; Volume 2 provides guidance for users of the ICD; and Volume 3 is the alphabetical index to the classification. Classification is divided into 21 chapters. The first character of the ICD code is a letter. Each letter is associated with a particular chapter, e.g. the letter D is used in both chapter II «Neoplasms» and chapter III «Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism». The topography code in Volume 3 describes the site and the behaviour of the neoplasm: malignant, secondary or metastatic, in situ, benign or of unknown behaviour. The morphology codes listed in Volume 1 are the same as those used in the special adaptation of the ICD for oncology, the ICD-O97.

Logo: Elsbeth Kuehni, Bern
Layout: HP Hauser, Bern

Schweizer Kinderkrebsregister
Registre Suisse du Cancer de l'Enfant
Registro Svizzero dei Tumori Pediatrici
Swiss Childhood Cancer Registry

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Swiss Paediatric Oncology Group